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(54) Title: SIGNALLING IN A TELECOMMUNICATIONS SYSTEM
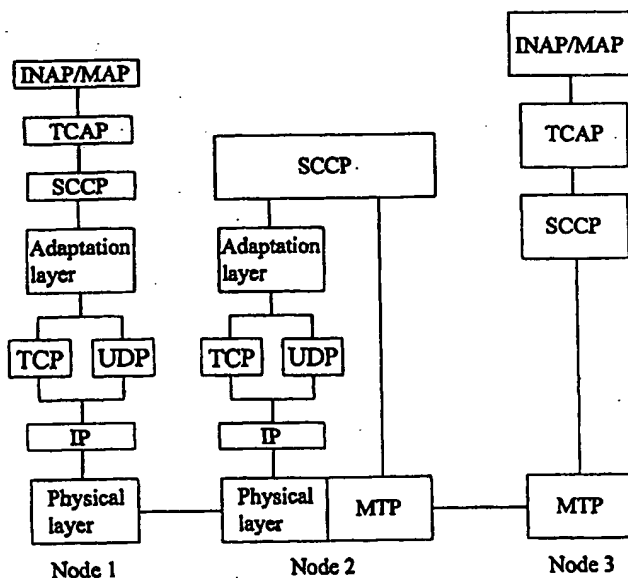
(57) Abstract

A method of transmitting signalling information in a Public Land Mobile Network (PLMN) between a pair of peer application parts. An adaptation layer is interposed between the SCCP of an SS7 network and a TCP/IP part to allow signalling data to be transmitted to and from the SCCP via an IP based network. The adaptation layer provides for translation between Destination Point Codes (DPCs) and or global titles, used as addresses in the SS7 network, and IP addresses/port numbers for use in the IP network. The adaptation layer also provides for formatting of SCCP messages suitable for processing by the TCP/IP layers, and also for formatting signalling information flowing in the reverse direction.

Signalling in a Telecommunications System

Field of the Invention

The present invention relates to signalling in a
telecommunications system and in particular, though not
necessarily, to the transmission of signalling data in a
Public Land Mobile Network.

Background to the Invention

In a telecommunications system, signalling equipment and
signalling channels are required for the exchange of
information between system elements or nodes. In
particular, this internode signalling informs the nodes
of what is to be performed when a telephone or data call
is to be set up or released in so-called "circuit-
switched" connections. Signalling is also often used to
communicate information on the status of the system and
of individual subscribers.

Modern telecommunications systems now largely make use
of Common Channel Signalling (CCS) whereby signalling
information is transmitted on one or more dedicated
signalling channels, distinct from the channels used to
carry actual user information (e.g. voice or data). An
important feature of CCS is that the same signalling
system may support services in a variety of existing
telecommunications networks, e.g. Public Switched
Telephone Network (PSTN), Integrated Services Digital
Network (ISDN), and Public Land Mobile Networks (PLMN),
as well as proposed future protocols such as B-ISDN,
enhancing greatly the interoperability of networks
supporting different protocols.

Currently, the predominant CCS is known as Signalling
System Number 7 (SS7), defined in the ITU-T
(International Telecommunications Union - Technical)
recommendations starting with Q.700. SS7 is a packet
switched system occupying one time slot per frame of the
Time Division Multiple Access (TDMA) E.1 or T.1
transmission formats (the other time slots being
available for user voice or data information).
Individual signalling message packets (referred to as
Message Signalling Units or MSUs) are associated with
respective individual telephone calls. As only a
relatively small amount of signalling information is
associated with a single telephone call, a single SS7
channel is able to handle all signalling between two
network nodes (termed "signalling points") for several
thousands of calls. It is noted that the route taken by
an MSU in the SS7 network may be the same as that over
which the associated telephone call is established, or
it may be different.

As already noted, SS7 (along with other CCS systems) is
able to support a number of different telecommunications
networks (e.g. PSTN, ISDN, PLMN). In signal processing
terms, SS7 comprises a Message Transfer Part (MTP) which
deals with the physical transfer of signalling
information over the signalling network (MTP layer 1),
message formatting, error detection and correction, etc
(MTP layer 2), and message routing (MTP layer 3). SS7
also comprises user parts and application parts which
allow several "users" (i.e. ISDN User Part, Telephony
User Part, Mobile Application Part, etc) to send signals
in the same signalling network.

Figure 1 illustrates a PLMN (GSM) having a Gateway
Mobile Switching Centre (GMSC) 1 which provides an
interface for the PLMN to "foreign" networks such as

ISDNs, PSTNs, and other PLMNs. An exemplary Mobile
Station (MS), registered to the PLMN, is indicated by
the reference numeral 2. A number of exemplary nodes
within the PLMN are also shown including: the GMSC 1; a
Mobile Switching Centre (MSC) 3; a Base Station
Controller (BSC) 4; a Base Transceiver Station (BTS) 5;
an Intelligent Network node (IN) 6; a Visitor Location
Register (VLR) 7; a Home Location Register (HLR) 8; an
Authentication Centre (AUC) 9; and an Equipment Identity
Register (EIR) 10. A more complete description of a
PLMN, and other aspects of telecommunication networks,
is given in "Understanding Telecommunications", vols. 1
& 2, Studentlitteratur, Lund, Sweden (ISBN 91-44-00214-
9).

Figure 1 indicates the various signalling interfaces
which are used to signal between the network nodes
detailed above. These interfaces include: the ISUP/TUP
interfaces between the GMSC 1 and the foreign networks;
the INAP interface used between the MSC 3 and
Intelligent Network (IN) nodes; the MAP interface used
between the MSC/GMSC 1,3 and PLMN specific nodes (VLR,
HLR, AUC, EIR) 6-10; the BSSMAP used between the MSC 3
and the BSC 4; and the Abis interface between the BSC 4
and the BTS 5. Conventionally, all of these interfaces
serve as user parts and application parts of an SS7
network, residing above the MTP layers. The resulting
protocol stacks are illustrated in Figure 2.

In order to provide the INAP and MAP (as well as certain
other application parts, e.g. OMAP, which also rely upon
connectionless communication over the signalling
network) with certain functions and protocols as well as
a standard and common interface between the application
parts and the network signalling service, a Transaction
Capabilities Application Part (TCAP or TC) is interposed

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between these application parts and the MTP.
Furthermore, a Signalling Connection and Control Part
(SCCP) is interposed between the TCAP and the MTP for
controlling the signalling connection. The SCCP is also
used by certain other application parts (referred to as
SCCP users, e.g. BSSMAP) which do not use the services
of the TCAP and which rely upon connection-oriented
and/or connectionless communication over the signalling
network.

SS7 makes use of addresses known as Destination Point
Codes (DPCs) to route signalling data through the
"visibility area" of a telecommunications network, the
visibility area typically being the network itself
together with the interfaces between the network and
"foreign" networks under the control of other operators.
A DPC is placed in the header of an MSU and is examined
by a network signalling point (SP) upon receipt of the
MSU to determine the next hop for the MSU *en route* to
its destination. So-called Subsystem Numbers (SSNs) are
used by SS7 to direct data to specific application parts
(see below) and are also included in MSUs.

With reference to Figure 2, it is noted that routing
between various application parts above the SCCP layer
is achieved using so-called "global titles". A global
title contains (amongst other things) a number dialled
in the PLMN or the number of a roaming mobile station
(for the specific example shown in Figure 1). The SCCP
contains all the network and routing information
required to analyse a global title and translate it into
a DPC and, optionally, a Subsystem Number (SSN) which
identify the next or final signalling point in the SS7
network.

In an SS7 network, any change in the DPC allocation
within the visibility area requires the operator to
update the DPC database (or routing table) which exists
in each SP of the network. This however adds
significantly to the maintenance overheads of the
network. The dedicated nature of SS7 makes it in
general expensive to install and maintain (in relation
to both hardware and software), a significant barrier
especially to prospective new telecom operators.
Furthermore, as an SS7 network occupies bandwidth on
TDMA frames of the E.1/T.1 transmission protocols (one
slot per time frame), the bandwidth available for actual
user call data is restricted. Yet another disadvantage
of traditional signalling architectures is that the
interoperability of SS7 networks is limited due to the
dedicated nature of the MTP physical layers.

Summary of the Present Invention

It is an object of the present invention to overcome or
at least mitigate the above noted disadvantages of
existing telecommunication signalling systems.

According to a first aspect of the present invention
there is provided a method of transmitting signalling
information in a telecommunications network between a
pair of application parts, the method comprising;
        generating said signalling information at a first
of said application parts, including addressing
information associated with the second of the
application parts;
        passing the signalling information to a Signalling
Connection Control Part (SCCP) arranged to segment the
signalling information if necessary, and to encapsulate
the information in one or more SCCP messages;
        passing the encapsulated signalling information
from the SCCP to an adaptation layer arranged to

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determine an IP address and port number associated with
said addressing information;

      passing the signalling information and said IP
address and port number to an Internet Protocol (IP)
part and transmitting the signalling information over an
IP network to said IP address in one or more IP
datagrams;

      decapsulating said signalling information at the
destination associated with the IP address and at an
adaptation layer identified by said port number; and

      routing the decapsulated signalling information to
the second user part.

The use of the IP based network for transmitting
signalling information reduces the need for conventional
signalling infrastructure (although this may still be
used in part). IP based networks offer increased
flexibility (e.g. routers of the network have self-
updating routing tables) and reduced operating,
maintaining, and engineering costs in comparison with
conventional telecommunications signalling networks.

The method of the present invention is particularly
applicable to Public Land Mobile Networks (PLMN), where
said pair of application parts may be, for example, peer
Mobile Application Parts (MAPs) or Intelligent Network
Application Parts (INAPs) present at respective
signalling nodes of the PLMN.

In certain embodiments of the invention, the SCCP
performs a translation between said addressing
information (e.g. a global title) and an associated
Destination Point Code (DPC) and, optionally, a
Subsystem Number (SSN). In this case, the IP address
and port number are determined, at the adaptation layer,
by way of the DPC, rather than directly from the global
title. In other embodiments however, the IP address and

port number are obtained at the adaptation layer
directly from a global title.

Preferably, the adaptation layer is arranged to monitor
the state of the signalling connection over the IP based
network and to report on this to the SCCP.

Preferably, the signalling information is passed from
the adaptation layer to the IP part via a UDP or TCP
encapsulating layer. More preferably, the adaptation
layer is arranged to encapsulate signalling and
addressing information into a form suitable for further
processing by the UDP or TCP layers.

The signalling information generated at the first
application part may be passed to the SCCP via a
Transaction Capabilities Application part.
Alternatively, the application part may pass information
directly to the SCCP. It is noted that a function of
the SCCP is to facilitate both connectionless and
connection oriented communication over the signalling
channel, in addition to its routing and encapsulation
functions.

According to a second aspect of the present invention
there is provided apparatus for transmitting signalling
information in a telecommunications network between a
pair of application parts, the apparatus comprising;
      generating means for generating said signalling
information at a first of said application parts,
including addressing information associated with the
second of the application parts;
      a Signalling Connection Control Part (SCCP)
arranged to receive said signalling information and to
segment the signalling information if necessary, and to
encapsulate the information in one or more SCCP
messages;

an adaptation layer arranged to receive the
encapsulated signalling information and to determine an
IP address and port number associated with said
addressing information;

an Internet Protocol (IP) part receiving the
signalling information and said IP address and port
number and for arranging transmission of the signalling
information over an IP network to said destination IP
address in one or more IP datagrams;

an adaptation layer at the destination associated
with the IP address, and identified by said port number,
for decapsulating said signalling information; and

routing means for routing the signalling
information to the second user part.

According to a third aspect of the present invention
there is provided a gateway node for coupling signalling
information from a common channel signalling (CCS)
network of a telecommunications system, to an Internet
Protocol (IP) based network, the gateway node
comprising:

a Message Transfer Part (MTP) arranged to receive
signalling information over the CCS network;

a Signalling Connection Control Part (SCCP)
arranged to receive said signalling information from the
MTP whilst controlling the signalling connection over
the CCS network;

an adaptation layer arranged to receive said
signalling information from the SCCP in the form of one
or more SCCP messages, to determine an IP address and
port number associated with a global title or
Destination Port Code (DPC) included in the SCCP
message(s), and to control the connection over the IP
based network;

an IP layer for receiving the signalling
information and the IP address and port number from the
adaptation layer and for arranging for transmission of

the signalling information over the IP based network in
the form of IP datagrams.

Brief Description of the Drawings

For a better understanding of the present invention and
in order to show how the same may be carried into effect
reference will now be made, by way of example, to the
accompanying drawings, in which:

Figure 1 illustrates schematically a GSM network
together with the signalling protocols used therein;

Figure 2 illustrates schematically the signal
processing layers of an SS7 protocol of the network of
Figure 1;

Figure 3 illustrates schematically the use of a
TCP/IP network to transmit signalling information in a
telecommunications network; and

Figure 4 illustrates signalling protocol layers
present at nodes of the telecommunications network of
Figure 3.

Detailed Description of Certain Embodiments

The general structure in terms of signalling nodes and
signalling interfaces of a GSM PLMN has already been
described above with reference to Figures 1 and 2.
Figure 3 shows various nodes of the GSM PLMN where it is
assumed, for the purpose of this discussion, that each
of these nodes comprises an application part (e.g. MAP,
INAP) having a conventional composition such that it can
be supported by SS7 for the sending of signalling
information to a peer application part at some other
node. Considering in particular the MSCs 3a,3b and the
GMSC 1, these nodes are connected to a conventional SS7
network 11 for the purpose of communicating signalling
information.

Intelligent network and mobile network specific nodes,
including the IN node 6, VLR 7, HLR 8, AUC 9, and EIR
10, each have application parts (and in particular MAP
and INAP) similarly constructed for peer-to-peer
communication via SS7. However, these nodes each
comprise an additional interface which enables them to
communicate signalling information via an IP network 12.
In order to enable interworking of the SS7 connected
nodes and the IP network connected nodes, the two
signalling networks 11,12 are connected by a gateway
node 13.

Figure 4 shows schematically the protocol layers present
at a node connected to the IP network 12 (Node 1), at
the gateway node 13 (Node 2), and at a node connected to
the SS7 network 11 (Node 3). Of the layers shown, the
INAP/MAP, TCAP, SCCP, TCP/UDP,IP, physical layer, and
MTP are substantially conventional in structure and
therefore will not be described in detail. Rather, the
reader should make reference to the literature including
"Understanding Telecommunications", vols. 1 & 2,
Studentlitteratur, Lund, Sweden (ISBN 91-44-00214-9),
and the ITU-T (International Telecommunications Union -
Technical) recommendations starting with Q.700 which
define Signalling System Number 7 (SS7). The present
discussion is concerned in the main with the Adaptation
layer which enables the TCP/IP and physical layers to
replace the MTP, such that peer SCCPs can communicate
over the IP network 12.

As has already been discussed above, MSUs are routed to
a signalling point in an SS7 network using Destination
Point Codes (DPCs) which are attached to each of the
MSUs. Within a signalling point, messages are directed
to a specific application (e.g. HLR, VLR, etc) on the

basis of a Subsystem Number (SSN) also attached to the
MSU. On the other hand, datagrams in an IP network are
routed to a destination machine on the basis of an IP
address, and to an application running on a particular
machine on the basis of an IP port number. A main
function of the Adaptation layer therefore is to
translate from DPCs to IP addresses and port numbers, a
process which is achieved using a database associating
DPCs and IP addresses/port numbers. It is noted that
translation in the reverse direction, i.e. from IP
addresses/port numbers to DPCs, is not normally
necessary as the MSU will in any case contain the DPC
(or a global title from which the DPC can be
determined).

At Node 1, for signalling data to be transmitted to Node
3, the adaptation layer determines an IP address and
port number associated with the DPC/SSN contained in the
message "primitive" received from the SCCP layer (this
primitive is referred to as an SCCP message). The
Adaptation layer then encapsulates the primitive into a
format which is acceptable to the TCP (or UDP layer)
before passing the information to the TCP (or UDP)
layer. A further function of the Adaptation layer is to
monitor the state of the connection between the two
communicating peer application parts. For example, if
communication between the application parts breaks down,
and cannot be re-established, then the Adaptation layer
may report this to the SCCP. It will be appreciated
that the Adaptation layer communicates with the SCCP in
a manner identical to that of the MTP.

After processing by the TCP (or UDP) layer, the messages
are passed to the IP layer, the main function of which
is to handle routing of datagrams over the IP network.

The messages transmitted over the IP network 12 have the
following structure:

Physical header	IP header	UDP/TCP header	SIO	SCCP header	TCAP header	INAP/MAP data

where SIO is the Service Information Octet (which, in
certain circumstances, may be omitted).

At the gateway node 13 (Node 2 in Figure 4), the
Adaptation layer is interposed between the TCP-UDP/IP
layers and the SCCP. The adaptation layer provides
again for translation between DPCs and IP addresses/port
numbers. Thus, for a signalling datagram received over
the IP network 12, the Adaptation layer decapsulates the
message and passes it to the SCCP for further
processing.

For transmission over the SS7 network 11, the SCCP
passes the primitive to the MTP which handles
transmission in a known manner. Similarly, the protocol
layers at the receiving node (Node 3) correspond to the
conventional SS7 structure.

It will be appreciated by the skilled person that
various modifications may be made to the above described
embodiment without departing from the scope of the
present invention. For example, the connectivity of the
network nodes shown in Figure 3 may be varied, such that
certain IN/PLMN specific nodes are connected to the SS7
network, whilst the MSCs and/or the GMSC may be
connected to the IP network. It may also be the case
that nodes are connected to both the SS7 network and the
IP network, such that one network provides a back-up for
the other network. It is also possible to connect all
nodes to two or more SS7 networks, with these networks
being connected together via an IP based networks and a
number of SS7/IP gateway nodes.

In a further modification to the above embodiment, the
TCAP may be omitted from the processing chain, e.g.
where the user application does not require the services
of the TCAP. In this case, the messages transmitted
over the IP network may have the structure given below.

Physical header	IP header	UDP/TCP header	SIO	SCCP header	SCCP user data

Claims

1. A method of transmitting signalling information in a telecommunications network between a pair of application parts, the method comprising;

generating said signalling information at a first of said application parts, including addressing information associated with the second of the application parts;

passing the signalling information to a Signalling Connection Control Part (SCCP) arranged to segment the signalling information if necessary, and to encapsulate the information in one or more SCCP messages;

passing the encapsulated signalling information from the SCCP to an adaptation layer arranged to determine an IP address and port number associated with said addressing information;

passing the signalling information and said IP address and port number to an Internet Protocol (IP) part and transmitting the signalling information over an IP network to said IP address in one or more IP datagrams;

decapsulating said signalling information at the destination associated with the IP address and at an adaptation layer identified by said port number; and

routing the decapsulated signalling information to the second user part.

2. A method according to claim 1, wherein said pair of application parts are peer Mobile Application Parts (MAPs) or Intelligent Network Application Parts (INAPs) present at respective signalling nodes of a Public Land Mobile Network (PLMN).

3. A method according to claim 1 or 2 and comprising determining the IP address and port number at the

adaptation layer from a Destination Point Code (DPC) included in said addressing information.

4.   A method according to claim 1 or 2 and comprising obtaining the IP address and port number at the adaptation layer directly from a global title included in said addressing information.

5.   A method according to any one of the preceding claims and comprising monitoring at the adaptation layer the state of the signalling connection over the IP based network and reporting on this to the SCCP.

6.   A method according to any one of the preceding claims and comprising encapsulating at the adaptation layer the signalling and addressing information into a form suitable for further processing by a UDP/TCP layer disposed between the adaptation layer and the IP part.

7.   Apparatus for transmitting signalling information in a telecommunications network between a pair of application parts, the apparatus comprising;

       generating means for generating said signalling information at a first of said application parts, including addressing information associated with the second of the application parts;

       a Signalling Connection Control Part (SCCP) arranged to receive said signalling information and to segment the signalling information if necessary, and to encapsulate the information in one or more SCCP messages;

       an adaptation layer arranged to receive the encapsulated signalling information and to determine an IP address and port number associated with said addressing information;

       an Internet Protocol (IP) part receiving the signalling information and said IP address and port

number and for arranging transmission of the signalling
information over an IP network to said destination IP
address in one or more IP datagrams;

an adaptation layer at the destination associated
with the IP address, and identified by said port number,
for decapsulating said signalling information; and

routing means for routing the signalling
information to the second user part.

8.   A gateway node for coupling signalling information
from a common channel signalling (CCS) network of a
telecommunications system, to an Internet Protocol (IP)
based network, the gateway node comprising:

a Message Transfer Part (MTP) arranged to receive
signalling information over the CCS network;

a Signalling Connection Control Part (SCCP)
arranged to receive said signalling information from the
MTP whilst controlling the signalling connection over
the CCS network;

an adaptation layer arranged to receive said
signalling information from the SCCP in the form of one
or more SCCP messages, to determine an IP address and
port number associated with a global title or
Destination Port Code (DPC) included in the SCCP
message(s), and to control the connection over the IP
network;

an IP layer for receiving the signalling information and
the IP address and port number from the adaptation layer
and for arranging for transmission of the signalling
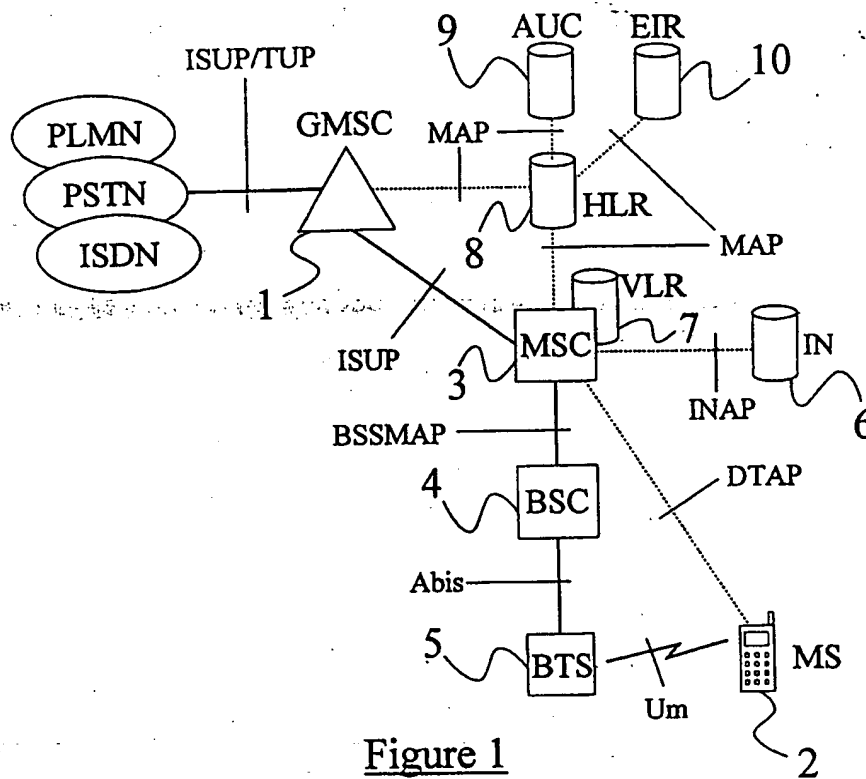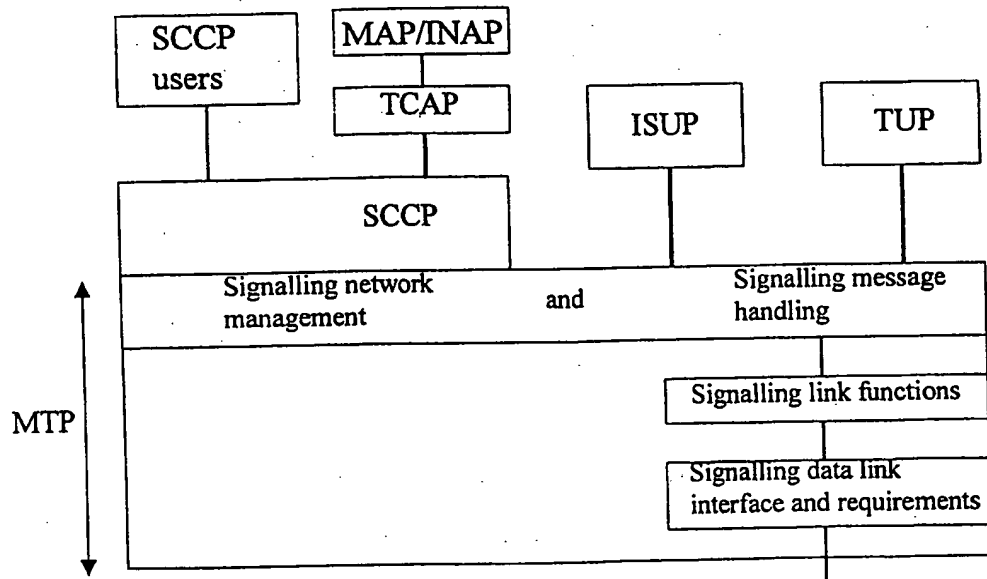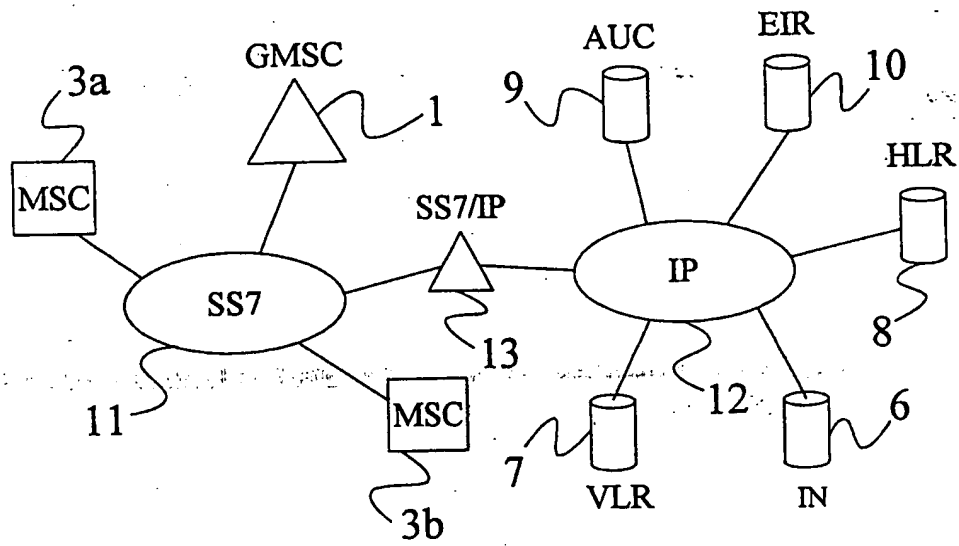information over the IP based network in the form of IP
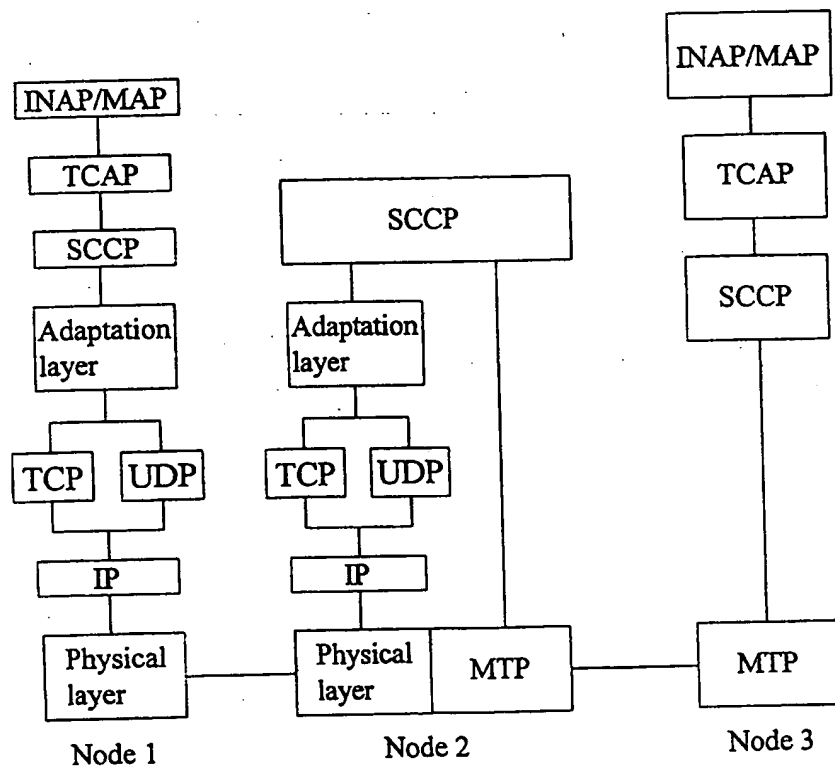datagrams.

Figure 1

Figure 2

Figure 3

Figure 4

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04Q3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SEVCIK M ET AL: "CUSTOMERS IN DRIVER'S SEAT: PRIVATE INTELLIGENT NETWORK CONTROL POINT" PROCEEDINGS OF THE INTERNATIONAL SWITCHING SYMPOSIUM,DE,BERLIN, VDE VERLAG, vol. SYMP. 15, page 41-44 XP000495622 ISBN: 3-8007-2093-0 page 42, left-hand column, line 37 -right-hand column, line 51	1,2,7,8
Y	figure 2	3,4
X	US 5 793 771 A (DARLAND ET AL.) 11 August 1998 (1998-08-11) abstract column 2, line 21 -column 3, line 63 column 5, line 40 -column 6, line 7	1,5-8

-/-

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

Date of the actual completion of the international search	Date of mailing of the international search report
13 January 2000	28/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl. Fax: (+31-70) 340-3016	Larcinese, C

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 42774 A (TELEFONAKTIEBOLAGET LM ERICSSON) 13 November 1997 (1997-11-13) abstract page 4, line 8 -page 6, line 16 figure 4	1,6-8
Y	US 5 706 286 A (REIMAN ET AL.) 6 January 1998 (1998-01-06) abstract column 10, line 42 -column 11, line 13	3,4

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5793771	A	11-08-1998	CA	2258597 A	31-12-1997
			EP	0917786 A	26-05-1999
			WO	9750217 A	31-12-1997
WO 9742774	A	13-11-1997	US	5870565 A	09-02-1999
			AU	2795797 A	26-11-1997
US 5706286	A	06-01-1998	US	5966431 A	12-10-1999